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(Title) **SORPTION-SUPPORTED AC-SYSTEM IN A PRINTING OFFICE**

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SORPTION-SUPPORTED AIR-CONDITIONING IN A PRINTING OFFICE

Synopsis

One of the first sorption-supported air-conditioning systems ("Desiccative Evaporative Cooling Systems") in an industrial building in Germany was installed in a printing office in Waiblingen, a town in southern Germany. The circumstances for such a system showed to be optimal, as the printing office is equipped with its own co-generation system delivering a considerable amount of waste heat. The experiences made with the system in the hot and humid summer of 1995 were very positive. Even when the outdoor-temperature reached about 32 °C, the temperature and humidity set points of 20 °C and 80 % relative humidity could be realized.

1. Sorption-supported Air-conditioning – Innovative Ventilation Technology in the Industrial Environment

The main feature of sorption-supported air-conditioning is the separation of the cooling and dehumidification processes. When so far the water was removed from the air by cooling the air below the dew point, now the water vapour is linked to solid or liquid hygroscopical substances. The so-called "sorption regenerator" is widely known. It is different from the traditional regenerator only in so far as it uses another kind of storage medium for heat recovery purposes. The hygroscopical features are caused by impregnation with saline solutions or by deposition of solid adsorbents. This way of air dehumidification combined with other components leads to a completely new generation of air-conditioning systems. The integration of sorption-supported dehumidification with both heat recovery and air moisturisation by evaporative cooling is well advanced in Germany.

The most important progress in developing sorption-supported air-conditioning systems was to replace the driving forces of the refrigeration process. While classical chillers need electric current, sorption-supported air-conditioning uses heat as driving force.

2. An example from real life – the "Druckhaus Waiblingen", DHW (Waiblingen Printing Office)

In the meantime, the sorption-supported air-conditioning technology has finished the laboratory-stadium. The following report describes a printing-office in Waiblingen, Germany, which was equipped with sorption-supported air-conditioning. Two central preconditions had to be realized: on the one hand the surplus waste heat of the company co-generation system occuring during the summer season ought to be reintegrated into the energy-circuit. On the other hand the capacity of the co-generation system was not to be weakened by the chillers'

high connected load. Besides, the required indoor air quality level in printing-offices is very high. Especially 4-colour printing at high speeds needs constant levels of temperature and humidity. All these demands can be fulfilled by cold production based on dehumidification with subsequent evaporative cooling (Desiccative evaporative cooling, sorption-supported air-conditioning).

Fig. 1: The Waiblingen Printing Office ("Druckhaus Waiblingen", DHW)

3. No CFC-containing refrigerants

The following features of sorption-supported air-conditioning, also known as Desiccative Evaporative Cooling, DEC, characterize the Waiblingen Printery compared to conventional refrigeration:

- use of water instead of CFC-containing refrigerants
- possible use of free waste heat
- the connected load is only about 60 per cent
- the saving potential of electric energy is up to 40 per cent
- comparable investment

Both devices installed in the printing-office are laid out for a supply flow of 27,000 m^3/h and a cooling capacity of 110 kW each. The temperature and humidity set points of 20 °C and 80 % relative humidity can be realized even at outdoor-temperatures above 30 °C in order to guarantee constantly good printing results.

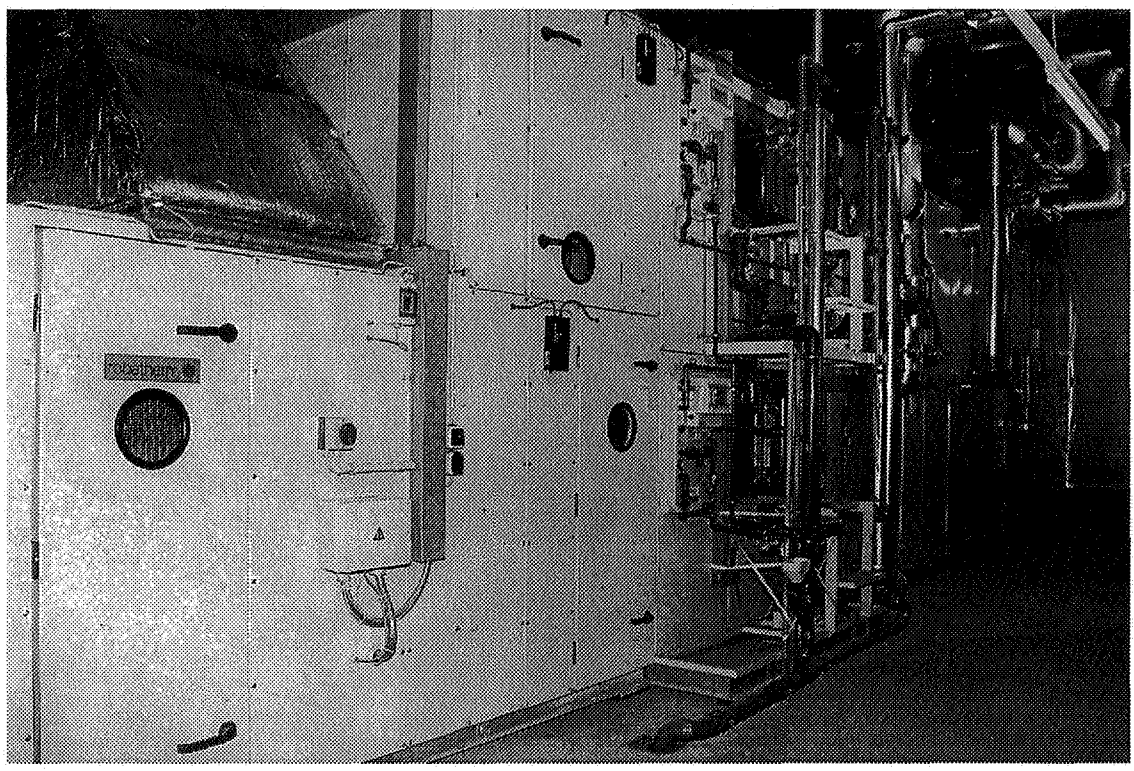

Fig. 2: View of the central unit of the sorption-supported air-conditioning system

The control parameters of sorption-supported air-conditioning are:

- the humidity degree of the infinitely variable air humidifier,
- the heat efficiency of the heat recovery unit,
- the thermal output of the regenerative air heater,
- the volume flow of the regenerative air ventilator.

Due to individually developped control strategies, it is possible to adjust the succession of the various control parameters in accordance with the system or the unit respectively. In this way, electric current and heat can be applied suitably to availability and need.
The experiences made during the hot and humid summer of 1995, when the printery was first air-conditioned by the sorption-supported system, confirmed all expectations.

4. Cooling by Evaporation

Sorption-supported air-conditioning is suitable for cooling and dehumidification of air both in human and process related air-conditioning, not, however, for the refrigeration of liquids or for the operation of cold-storage rooms. The operational principle is less complicated than could be assumed (see figure 1): The aspirated filtered outside air (1) is dried by means of a sorbate regenerator (2). During this process heat of condensation is released leading to a temperature increase. Afterwards the air is precooled in a heat recovery system (3) by heat transfer from the incoming part to the outgoing part. During winter time a reheater (4) has to assure good functioning. Further cooling to the temperature level of the supply air is realized by a controllable evaporative cooler (5).

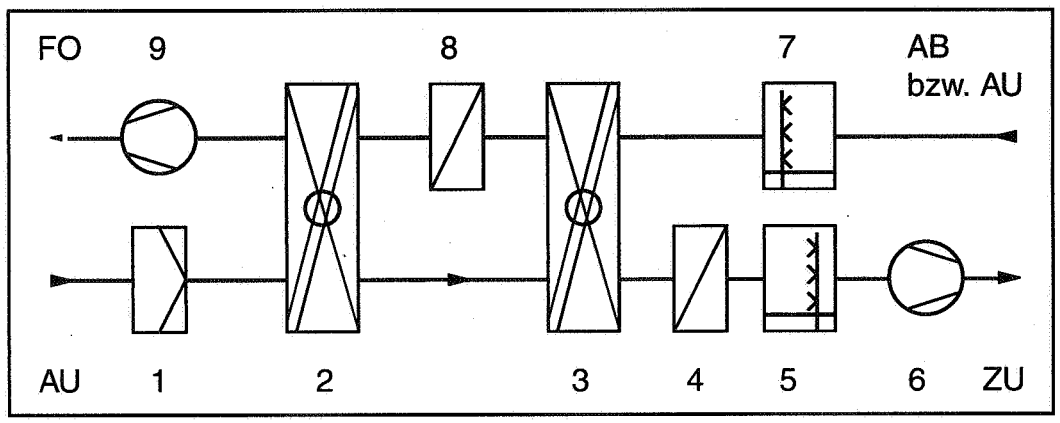

Fig. 3: Schematic description of a sorption-supported AC-system

Due to the effectiveness of evaporative cooling the prevailaing outdoor air condition results in a temperature decrease. The supply air is warmed up by the power input of the supply air fan; therefore this power input must be taken into account when the supply air temperature is to be determined.

The regeneration flow which is directed inversely to the supply air is usually realized by the outgoing air. First of all, the outgoing air is cooled down and humidified by means of a second evaporative cooler (7). Afterwards it flows through the heat recovery system (3) realizing hereby the precooling of the supply air as described above. After leaving the heat recovery system the outgoing air is heated and this process enables the desorption, i. e. the regeneration of the sorption regenerator (2).

5. Reduced Operating Expenses Allow Economical Operation

With regard to cost of production and investment the technologies of sorption-supported air-conditioning and of classical cold production have to be compared in relation to the project and in view of the specific basic conditions. In principle, these costs can be considered as being on the same level as conventional units for the fact that, in every respect, soprtion-supported air-conditioning is based on customary and reliable ventilation components. Whenever the use of sorption-supported air-conditioning brings in economic advantages, in most cases this is due to savings on the part of the operating expenses. Compared to air-conditioning units with electrically driven refrigerating machines, the consumption of the individual devices and unit components is differing, possibly leading to reduced costs of water, electric power and work. In addition, the heat recovery units guarantee that the year-round heat consumption corresponds roughly to the consumption of an air-conditioning system with refrigerating machine and standard heat recovery. The use of utility-supplied heating, solar heating and anyway available waste heat shows to be particularly advantageous.

6. Conclusion

The experiences made at the Waiblingen printing office (DHW) prove that ecologically desirable ways of cold production can definitely turn out economical. It ought to be mentioned yet that the exact comparison of costs as well as the determination of a possible saving potential must be carried out in relation to the project.

Further information

Further information on behalf of this subject is available from the *Fachinstitut Gebäude-Klima e. V.*, Danziger Str. 20, D-74321 Bietigheim-Bissingen. Tel. +49-7142-54498, Fax -61298, as well as from *Robatherm Wärme- und Klimatechnik GmbH*, Industriestr. 21-27, D-89331 Burgau, Tel. +49-8222-999-0, Fax -999-222, and from the *Institut für Luft- und Kältetechnik gGmbH*, Bertolt-Brecht-Allee 20, D-01309 Dresden, Tel. +49-351-4081-650, Fax -4081-655.